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(56) Documents cited

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(58) Field of search

B1W

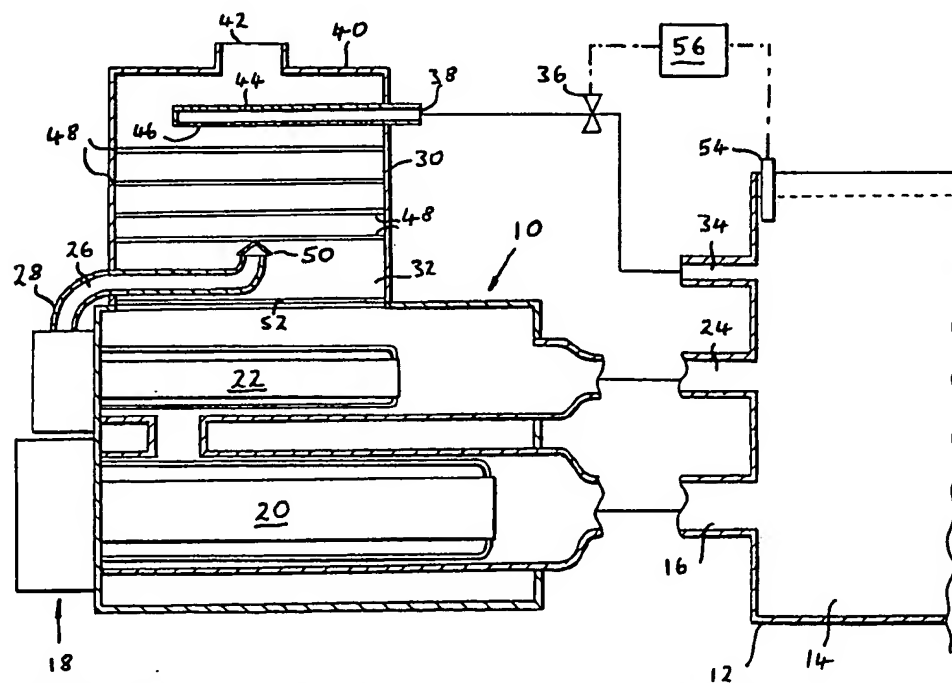
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Selected US specifications from IPC sub-class C02F

## (54) Method and apparatus for controlling the pH value of a liquid

(57) A swimming pool 12 containing water 14 has a pH meter 54 to measure the pH value. The temperature is maintained higher than the surrounding atmosphere by passing water drawn from the pool 12 via an outlet 16 through a fuel fired heater 18 and then back into the pool 18 through an inlet 24. The fuel fired heater 18 produces acidic products of combustion 26 which are vented to the atmosphere via a mixing chamber 30 having a flue outlet 42. When pH is higher than 7 i.e. is alkaline the meter 54 operates a valve 36 allowing water to be fed into the mixing chamber 30 through a water inlet 38 and a series of pipes 44. Perforated trays 48 collect and redistribute the water which contacts the acidic products of combustion 26 travelling up the chamber 30 which is then re-mixed with the water passing through the heater 18 thus lowering the pH to a preset value equal to 7 which is neutral.



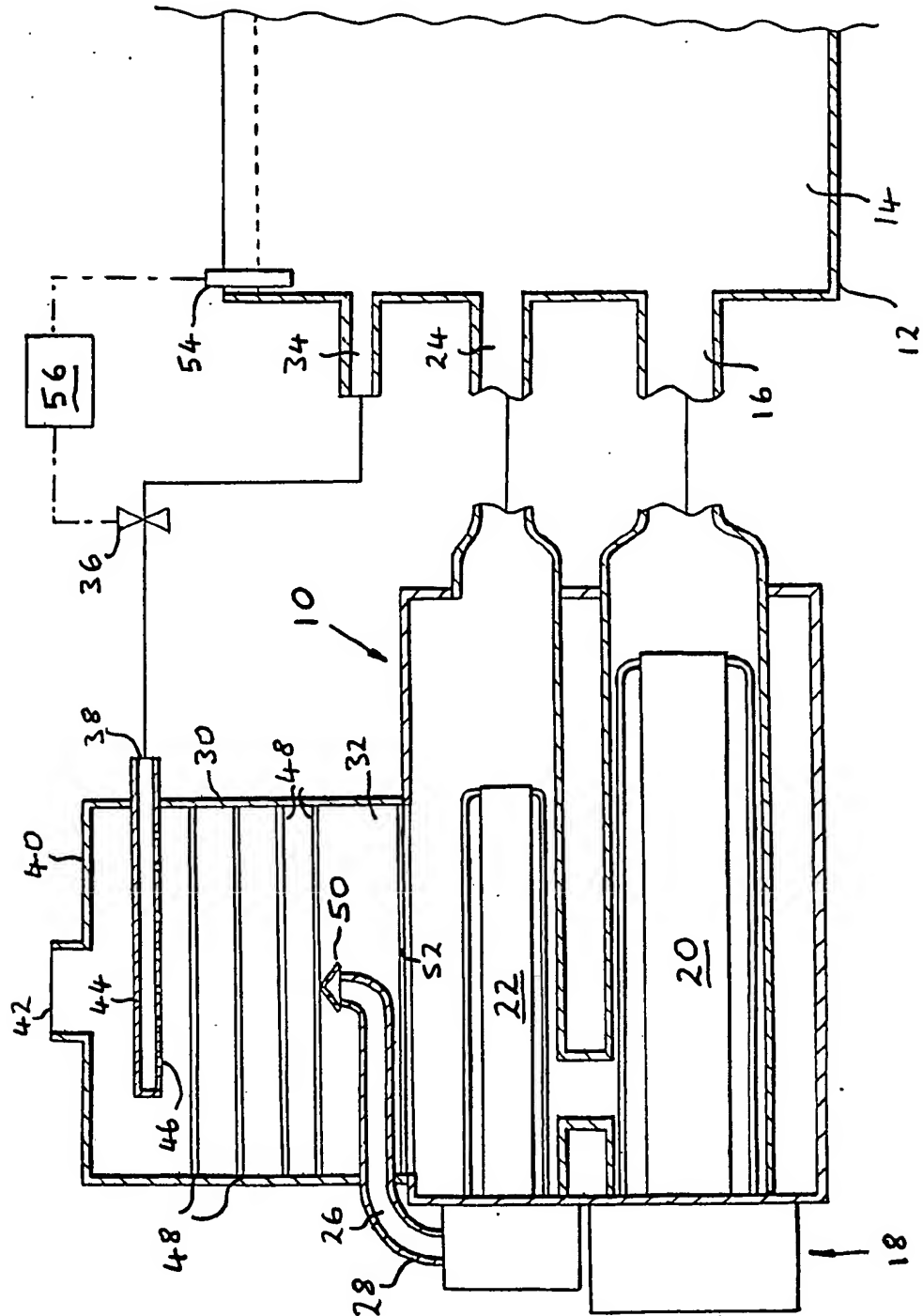
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## SPECIFICATION

**Method and apparatus for controlling the pH value of a liquid**

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This invention concerns a method and apparatus for controlling the pH value of a liquid, especially the pH value of water in public or private swimming baths.

- 10 A liquid's pH value is a measurement of its concentration of hydrogen ions. A pH value of 7 indicates that the liquid is neutral. A pH value of more than 7 indicates an alkaline liquid and a pH value of less than 7 indicates that the liquid is acidic. Water is usually found to be approximately neutral. The pH value of water may be altered if it is contaminated. Water in private or public swimming baths, for example, will, over a period of time, become more alkaline as the pH of the water is raised due to the contamination of the water by alkaline substances produced by people using the water in the swimming baths. In order to maintain the water in the swimming baths at a pH value approximately equal to 7, it is usual to treat the water continuously or on an intermittent basis, with acid thus restoring the water to its neutral state. However, the constant requirement of acidic material specifically for such water treatment is expensive.

- It is common practice in public or private swimming baths to use a fuel fired water heater to raise the temperature of the water above that of ambient air to a temperature more acceptable to users. In addition to heat, the water heater also produces unusable products of combustion which are allowed to escape into the surrounding atmosphere. These products of combustion are normally acidic in nature.

- An object of the present invention is to provide apparatus for controlling the pH value of a liquid, especially the pH value of water in public or private swimming baths.

- 45 Pursuant hereto the present invention provides apparatus for controlling the pH of a liquid comprising a receptacle containing a liquid, a fuel fired liquid heater provided with a supply of liquid from the receptacle, said supply of liquid passing through the fuel fired liquid heater, operative to raise the liquid's temperature, and then returning to said receptacle, said fuel fired liquid heater producing products of combustion and having means wherein the products of combustion are mixed with and absorbed by the supply of liquid to the fuel fired liquid heater. The apparatus further including means to control the ratio of the products of combustion mixed with the supply of liquid.

- 60 Preferably the means to control the ratio of the products of combustion mixed with the supply of liquid comprises a device which measures the pH of the liquid in the receptacle and controls a valve operable to alter the

amount of the products of combustion supplied to the mixing means, the unwanted part of the products of combustion being allowed to escape via a vent to surrounding atmosphere.

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Advantageously the full amount of the products of combustion are supplied to the mixing means and a valve is provided operable to alter the amount of liquid supplied to the mixing means, said valve controlled by a device measuring the pH of the liquid.

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Advantageously the mixing means comprises a chamber having a set of sprays through which the supply of liquid enters the chamber and an inlet disposed so that the products of combustion entering the chamber there-through pass under the sprays thereby accomplishing the mixing of the products of combustion and the supply of liquid.

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Optionally, the chamber may contain capillary cells, contact plates or packing material to further enhance the mixing of the combustion products and the liquid supply.

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Preferably the liquid contained in the receptacle is water.

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The invention further provides a method of controlling the pH of a liquid comprising the steps of supplying a liquid from a receptacle to a fuel fired liquid heater operative to raise the liquid's temperature, returning said liquid to the receptacle via mixing means wherein the liquid is mixed with and absorbs products of combustion produced by the fuel fired liquid heater and controlling the ratio of the products of combustion mixed with the supply of liquid.

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Advantageously the method includes the step of measuring the pH of the liquid in the receptacle and controlling the amount of the products of combustion supplied to the mixing means in relation to the measured pH and allowing unwanted products of combustion to escape to surrounding atmosphere.

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Preferably the pH of the liquid in the receptacle is measured and the amount of liquid supplied to the mixing means is controlled in relation to the measured pH.

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The invention will be described further by way of example with reference to the accompanying drawing in which the single figure is a sectional side view of a preferred embodiment of the apparatus according to the invention.

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Referring now to the figure a preferred embodiment of the apparatus for controlling the pH of a liquid, referred to generally by the reference numeral 10, includes receptacle 12 containing a volume of a liquid 14. In the preferred embodiment a public swimming baths has a pool 12 containing a volume of water 14 normally having a pH value approximately equal to 7. The pool 12 has an outlet 16 where a constant amount of water 14 is drawn off and fed to a fuel fired water heater 18 of a known type. In the preferred embodiment the heater 18 comprises main heater 20

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and a secondary heater 22. This arrangement allows the heater 18 to be operated at a high capacity with both heaters 20, 22 operating and at a lower capacity with only the secondary heater 22 operating. After passing through the heater 18, the water 14 is returned to the pool 12 through an inlet 24. The fuel fired water heater 18 produces heat by burning a fuel, commonly oil, coal or gas, and the heat produced is used to raise the temperature of the water passing through the heater 18. This process also results in the production of combustion products 26 in the form of hot gases. The combustion products 26 of such a heater 18 are well known to be slightly acidic when dissolved in water. The water heater 18 has an outlet pipe 28 to allow for removal of the combustion products 26. The outlet pipe 28 is connected to a mixing chamber 30 such that the combustion products 26 are fed into the mixing chamber 30 at its lower end 32. The mixing chamber 30 is provided with a supply of water 34 drawn from the pool 12. The rate at which water is supplied to the mixing chamber 30 is determined by a valve 36. The mixing chamber 30 has a water inlet 38 disposed at the chamber's top 40. Also at the chamber top 40 is a flue outlet 42 to allow unabsorbed combustion products 26 to leave the mixing chamber 30. The water inlet 38 is connected to a series of horizontal pipes 44 having holes 46 in their lower surfaces such that the water is allowed to leave pipes 44 as a series of droplets falling under gravity down the mixing chamber 30. A plurality of horizontal perforated trays 48 are provided in the tower at intervals to collect and then redistribute the water in a cascade-like manner. The outlet pipe 28 enters the mixing chamber 30 substantially horizontally and is angled central of the mixing chamber 30. In order to prevent water flowing down the chamber 30 from entering the pipe 28 a diffuser cap 50 is provided. Water at the bottom of the chamber 30 leaves via an outlet 52 into the heater 18. A pH meter 54 measures the pH of the water in the pool 12 and is connected to a control box 56 which in turn is connected to the valve 36 on the water supply 34 from the pool to the mixing chamber 30.

In use the apparatus operates as follows. The water heater 18 maintains the water 14 in the pool 12 at a constant preset temperature and as long as there is no change to the pH value of the water 14 in the pool 12, the valve 36 is closed and all the combustion products 26 are allowed to pass through the mixing chamber 30 without contacting water from the pool 12. There is no mixing of the water and the combustion products 26 when the apparatus is operating in this manner. If, due to use of the pool by humans (not shown) the pH value

opened and the combustion products 26 are allowed to mix with the water supply 34 drawn from the pool 12. During the mixing a certain amount of the combustion products 26 will be absorbed by the water producing a solution that is acidic, i.e. has a pH value of less than 7. When this water enters the heater 18 it will mix with alkaline water drawn direct from the pool 12 via the outlet 16 and neutralise it thus reducing the pH value to its normal level. When the pH meter 54 measuring the pH value of the water 14 in the pool 12 records this it will operate the valve 36 and reduce the amount of water allowed to mix with the combustion products 26 in the mixing chamber 30. In this way the pH value of the pool 12 is maintained at substantially the desired value. It will be further noted that the mixing chamber 30 also acts as a pre-heater for the fuel fired heater 18 as heat exchange occurs between the hot combustion products 26 and the colder water from the pool 12. In this way the overall efficiency of the heater 18 is increased above that normally obtained.

The invention is not confined to the precise details of the foregoing example and variations may be made thereto. Thus the mixing means can be other than water sprays, for example, the mixing can be accomplished by a direct immersion arrangement, capillary cells, water flow channels, packing materials, screens, filters, direct contact plates, film flow devices or flow diversion devices or any combination of these methods. Further, the fuel fired water heater may be a separate unit operating either in conjunction with or independently of another type of fuel fired appliance. Furthermore the valve 36 may be disposed on the combustion product outlet pipe 28 such that the amount of combustion products allowed to mix with the pool water is controlled by the pH meter 54. In such an arrangement the water 14 is fed into the mixing chamber first before entering the heater 18 and there would be no direct connection from the pool 12 to the heater 18. A combination of this arrangement and the preferred embodiment is also possible. Alternatively the fuel fired water heater may operate the heating to other areas, for example, space heating or shower systems etc. in addition to or in place of heating the pool water. Other variations may also be possible.

#### CLAIMS

1. Apparatus for controlling the pH of a liquid comprising a receptacle containing a liquid, a fuel fired liquid heater provided with a supply of liquid from the receptacle, said supply of liquid passing through the fuel fired liquid heater operative to raise the liquid's temperature, and then returning to said recep-

heater producing

means wherein the products of combustion are mixed with and absorbed by the supply of liquid to the fuel fired liquid heater, the apparatus further including means to control the ratio of the products of combustion mixed with the supply of liquid.

2. Apparatus as claimed in claim 1 in which the means to control the ratio of the products of combustion mixed with the supply of liquid comprises a device which measures the pH of the liquid in the receptacle and controls a valve operable to alter the amount of the products of combustion supplied to the mixing means, the unwanted part of the products of combustion being allowed to escape via a vent to surrounding atmosphere.

3. Apparatus as claimed in claim 1 wherein the means to control the ratio of the products of combustion mixed with the supply of liquid comprises a device for measuring the pH of the liquid in the receptacle, which device controls a valve operable to alter the amount of liquid supplied to the mixing means, all the products of combustion being constantly supplied to said mixing means.

4. Apparatus as claimed in claims 1, 2 or 3 wherein the mixing means comprises a chamber having a set of sprays through which the supply of liquid enters the chamber and an inlet disposed so that the products of combustion entering the chamber therethrough pass under the sprays thereby accomplishing the mixing of the products of combustion and the supply of liquid.

5. Apparatus as claimed in any preceding claim wherein the liquid is water in a swimming baths.

6. A method of controlling the pH of a liquid comprising the steps of supplying a liquid from a receptacle to a fuel fired liquid heater operative to raise the liquid's temperature, returning said liquid to the receptacle via mixing means wherein the liquid is mixed with an absorbs products of combustion produced by the fuel fired liquid heater and controlling the ratio of the products of combustion mixed with the supply of liquid.

7. A method as claimed in claim 6 wherein the pH of the liquid in the receptacle is measured and the amount of the products of combustion supplied to the mixing means is controlled in relation to the measured pH and allowing unwanted products of combustion to escape to surrounding atmosphere.

8. A method as claimed in claim 6 wherein the pH of the liquid in the receptacle is measured and the amount of liquid supplied to the mixing means is controlled in relation to the measured pH.

9. Apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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